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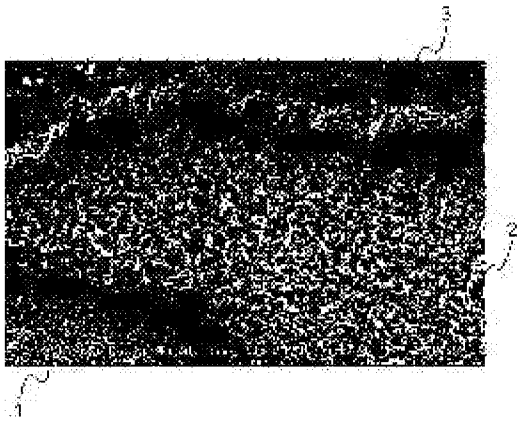
(71)Applicant : CENTRAL RES INST OF ELECTRIC POWER IND

(72)Inventor : FURUYA MASAHIRO
TOKIWAI MORIYASU
TAKAHASHI TAKESHI
KOBAYASHI HIROKAZU
TANAKA NOBUYUKI
MIKAMI MIKI
KURODA MASAHIRO

(54) MULTIFUNCTIONAL MATERIAL HAVING MIRROR FINISHED SURFACE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a multifunctional material having a mirror finished surface which has carbon doped in the state of Ti-C bond, is excellent in durability, has a carbon-doped titanium oxide layer functioning as a visible light active catalyst and is suitable for reflection of high-intensity light.



SOLUTION: The multi-functional material having mirror finished surface is obtained by heating the surface of base body, of which at least surface layer comprises titanium, titanium alloy, titanium alloy oxide or titanium oxide, in a combustion gas environment of gas consisting mainly of hydrocarbon such that the surface temperature becomes 900 to 1,500°C, or by performing the heating such that the surface temperature of the base body becomes 900 to 1,500°C by directly projecting combustion flame of gas consisting mainly of hydrocarbon to the surface of the base body and, further, by performing polishing treatment according to electrolytic polishing for the surface of the base body.

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]
Multifunctional material which has a mirror plane characterized by a thing consist of a carbon dope titanium oxide layer which at least a part of surface layer of a base turns into from titanium oxide or a titanium alloy oxide in which carbon was doped in the state of Ti-C combination, and it comes to give to this carbon dope titanium oxide layer mirror surface finish by polish.
[Claim 2]
Multifunctional material which has a mirror plane characterized by a thing consist of a carbon dope titanium oxide layer which has a height of a large number which at least a part of surface layer of a base becomes from titanium oxide or a titanium alloy oxide in which carbon was doped, and it comes to give to this carbon dope titanium oxide layer mirror surface finish by polish.
[Claim 3]
Multifunctional material which has at least a mirror plane characterized by a thing a layer which bristles with a detailed pillar which consists of titanium oxide or a titanium alloy oxide of a surface layer in which carbon was doped in part is exposed, and it comes to give to a layer which bristles with this detailed pillar mirror surface finish by polish.
[Claim 4]
Multifunctional material which has the mirror plane according to claim 2 characterized by what a detailed pillar which stands close together on an narrow height by which a large number which consist of titanium oxide or a titanium alloy oxide continued on a thin film, and this height is exposed, and is done for the carbon dope of this height and this detailed pillar.
[Claim 5]
Multifunctional material which has the mirror plane according to claim 2, 3, or 4 characterized by what doped carbon is contained for in the state of Ti-C combination.
[Claim 6]
a layer which consists of titanium oxide or a titanium alloy oxide by which the carbon dope was carried out -- carbon -- 0.3 - 15at% -- multifunctional material which has a mirror plane of a

statement in the any 1 paragraph according to claim 1 to 5 characterized by what is contained.

[Claim 7]

Multifunctional material which has the mirror plane according to any one of claims 1 to 6 which comprises a layer and heartwood which consist of titanium oxide or a titanium alloy oxide by which the carbon dope was carried out, and is characterized by what this heartwood is titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide.

[Claim 8]

It comprises a layer, an interlayer, and heartwood which consist of titanium oxide or a titanium alloy oxide by which the carbon dope was carried out, Multifunctional material which this interlayer is titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide, and has the mirror plane according to any one of claims 1 to 6 characterized by what this heartwood comprises construction material other than titanium, a titanium alloy, and titanium oxide for.

[Claim 9]

Multifunctional material which has the mirror plane according to any one of claims 1 to 8 characterized by a thing it comes to give mirror surface finish by electrolytic polishing or buffing.

[Claim 10]

Multifunctional material which has the mirror plane according to any one of claims 1 to 10 characterized by what a layer which consists of titanium oxide or a titanium alloy oxide of a surface layer by which the carbon dope was carried out is combined with the lower layer titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide for via Ti-C combination.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
The 1st invention has a layer which consists of titanium oxide or the titanium alloy oxide of a surface layer by which the carbon dope was carried out at least in part, This carbon is doped in the state of Ti-C combination, and carbon is doped in more detail by the surface layer in the state of Ti-C combination about the multifunctional material which has a mirror plane where it comes to give mirror surface finish by polish.
It is related with the multifunctional material which has a layer which is excellent in endurance (high hardness, scratch-proof nature, abrasion resistance, chemical resistance, heat resistance), and functions as a visible light response type photocatalyst, and has the mirror plane in which mirror surface finish was further performed to the surface layer, and which was excellent in the reflection effect of high intensity lights, such as laser.

The 2nd invention a mirror plane about the multifunctional material which it has in more detail, Since it has many heights of a surface layer which consist of titanium oxide or a titanium alloy oxide in part at least, it can stick also to a volatile organic compound (VOC) easily, Since the carbon dope of the surface area is carried out greatly, the activity as a photocatalyst functions as a visible light response type photocatalyst highly, Hardness is also high and it excels in peeling resistance, abrasion resistance, chemical resistance, and heat resistance, and since mirror surface finish is further performed to the surface layer, it is related with the multifunctional material which has the mirror plane excellent also in the reflection effect of high intensity lights, such as laser.
[Background of the Invention]
[0002]
Conventionally, titanium dioxide TiO_2 (in this specification and a claim, it is only called titanium oxide) is known as a substance which presents a photocatalyst function. As a method of forming titanium oxide membrane on a titanium metal, from the 1970s. The method of forming titanium oxide membrane by anodization on a titanium metal, the method of forming titanium

oxide membrane thermally on a titanium metal board in the electric furnace which supplied oxygen, The method of heating a titanium plate in the 1100-1400 ** flame of town gas, and forming titanium oxide membrane on a titanium metal, etc. are known (refer to nonpatent literature 1).

[0003]

When manufacturing the photocatalyst product from which the effect of deodorization, antibacterial properties, antifog, or antifouling is acquired by such a photocatalyst function, generally, spray coating, spin coating, dipping, etc. give titanium oxide sol on a base, and membranes are formed -- **** (for example, refer to patent documents 1-3) -- since it was easy to produce exfoliation and wear, the use over a long period of time was difficult for the coat formed such. How to form a photocatalyst coat by sputtering process is also known (for example, refer to patent documents 4-5).

[0004]

In order to operate titanium oxide as a photocatalyst, wavelength is required for ultraviolet rays of 400 nm or less, but many researches of the titanium oxide photocatalyst which dopes various elements and functions by visible light are done. For example, the titanium oxide which doped F, N, C, S, P, nickel, etc., respectively is compared, and there is a report that nitrogen dope titanium oxide is excellent as a visible light response type photocatalyst (refer to nonpatent literature 2).

[0005]

As a titanium oxide photocatalyst which doped other elements in this way, The titanium compound which replaces the oxygen site of titanium oxide by atoms, such as nitrogen, The photocatalyst which consists of a titanium compound which dopes atoms, such as nitrogen, between the lattices of the crystal of titanium oxide, or a titanium compound which arranges atoms, such as nitrogen, on the grain boundary of the polycrystal aggregate of a titanium oxide crystal is proposed (for example, refer to the patent documents 6 - 9 grade). However, such a photocatalyst is necessarily unsatisfying about the point of endurance, such as abrasion resistance. n-TiO_2-xCx which is chemical modification titanium oxide by applying the natural gas burning flame with which the temperature of the burning flame was maintained near 850 ** by adjusting the flow of natural gas and oxygen, for example to a titanium metal is obtained, There is a report of that this absorbs light of 535 nm or less (refer to nonpatent literature 3).

[0006]

. [whether the crystal nucleus produced by various processes, such as a CVD method or PVD, is put in the sol solution which comprises an inorganic metal compound or an organic metallic compound, and] Or by applying a sol solution to this crystal nucleus, solidifying it, heat-treating, and growing up a titanium oxide crystal from this crystal nucleus, the crystal form of the titanium oxide crystal grown up from the crystal nucleus accomplishes a columnar crystal -- high -- it is known that an activity photocatalyst function will be obtained (for example, refer to patent documents 10-12). However, since a columnar crystal only grows from the seed crystal only placed on the base in that case, the formed columnar crystal does not have the enough bond strength to a base, then the photocatalyst produced by making it such cannot necessarily

be satisfied about the point of endurance, such as abrasion resistance.

[Patent documents 1] JP,09-241038,A

[Patent documents 2] JP,09-262481,A

[Patent documents 3] JP,10-053437,A

[Patent documents 4] JP,11-012720,A

[Patent documents 5] JP,2001-205105,A

[Patent documents 6] JP,2001-205103,A (claim)

[Patent documents 7] JP,2001-205094,A (claim)

[Patent documents 8] JP,2002-95976,A (claim)

[Patent documents 9] The international publication 01st/No. 10553 pamphlet (CLAIMS)

[Patent documents 10] JP,2002-253975,A

[Patent documents 11] JP,2002-370027,A

[Patent documents 12] JP,2002-370034,A

[Nonpatent literature 1] A. Fujishima et al., J. Electrochem. Soc. Vol. 122, No. 11, p.1487-1489, November 1975

[Nonpatent literature 2] R. Asahi et al. and SCIENCE Vol. July 13, 2001 [293 or], p.269-271

[Nonpatent literature 3] Shahed U. M. Khan et al. and SCIENCE Vol. September 27, 2002 [297 or], p.2243-2245

[Description of the Invention]

[Problem(s) to be Solved by the Invention]

[0007]

In both an ultraviolet-rays response type thing and a visible light response type thing there is a problem in endurance (high hardness, scratch-proof nature, abrasion resistance, chemical resistance, heat resistance), and the here conventional titanium oxide system photocatalyst had become a neck in the field of utilization.

[0008]

then, the 1st invention -- as a surface layer -- endurance (high hardness and scratch-proof nature.) It aims at providing the multifunctional material which has a carbon dope titanium oxide layer which is excellent in abrasion resistance, chemical resistance, and heat resistance, and functions as a visible light response type photocatalyst, and has a mirror plane suitable for reflection of the high intensity light which is an elevated temperature of laser etc. further.

[0009]

The 2nd invention can stick also to VOC easily, and since the carbon dope of the surface area is carried out greatly, the activity as a photocatalyst functions as a visible light response type photocatalyst highly, It excels in peeling resistance, abrasion resistance, chemical resistance, and heat resistance, and aims at providing the multifunctional material which has a mirror plane suitable for reflection of high intensity light.

[Means for Solving the Problem]

[0010]

In order that this invention person may attain the above-mentioned purpose, as a result of inquiring wholeheartedly, a surface layer Titanium, The surface of a base which consists of a

titanium alloy, a titanium alloy oxide, or titanium oxide by heat-treating hydrocarbon at an elevated temperature using a burning flame of gas used as the main ingredients, and grinding to a surface layer further, carbon is doped in the state of Ti-C combination -- endurance (high hardness and scratch-proof nature.) It has carbon dope titanium oxide which is excellent in abrasion resistance, chemical resistance, and heat resistance, and functions as a visible light response type photocatalyst as a surface layer, finds out that a member (multifunctional material which has a mirror plane) suitable for reflection of high intensity light which is an elevated temperature of laser etc. is obtained, and came to complete this invention.

[0011]

Namely, multifunctional material which has the 1st mirror plane of this invention, A surface layer consists of a carbon dope titanium oxide layer at least, and this carbon is doped in the state of Ti-C combination, It comes to give mirror surface finish by polish to a surface layer, and excels in endurance, and functions as a visible light response type photocatalyst, and is characterized by being the multifunctional material (multifunctional material which has the 1st mirror plane) which was further suitable for a reflection effect of high intensity light.
It is characterized by things.

[0012]

A result wholeheartedly examined in order that this invention person might attain the above-mentioned purpose, A surface layer at least on the surface of a base which consists of titanium, titanium oxide, a titanium alloy, or a titanium alloy oxide Unsaturated hydrocarbon, By applying especially a burning flame of acetylene directly, and heat-treating under specific conditions, or heat-treating the surface of this base in combustion-gas atmosphere of unsaturated hydrocarbon, especially acetylene under specific conditions, A layer which bristles with a detailed pillar which becomes an inside of this surface layer from titanium oxide or a titanium alloy oxide is formed, A member which a layer which makes a layer which bristles with this detailed pillar cut towards meeting this surface layer, and bristles with a detailed pillar on this base which consists of this titanium oxide or a titanium alloy oxide in part at least has exposed, A member which a detailed pillar which stands close together on an narrow height by which a large number which consist of titanium oxide or a titanium alloy oxide continued on a thin film, and this height has exposed is obtained, Namely, a thing for which these both have many surface heights which consist of titanium oxide or a titanium alloy oxide in part at least, These both by carrying out the carbon dope of a detailed pillar which is a height which consists of that it is useful multifunctional material and this titanium oxide, or a titanium alloy oxide, and the continuous narrow height. Multifunctional material whose hardness photocatalyst activity was high, it functioned as a visible light response type photocatalyst, and also could stick also to VOC easily, and was also high and which was excellent in peeling resistance, abrasion resistance, chemical resistance, and heat resistance is obtained, And by grinding to a surface layer of the multifunctional material concerned, it found out that a reflection effect of high intensity lights, such as laser, was acquired, and this invention was completed.

[0013]

Namely, multifunctional material which has the 2nd mirror plane of this invention, It has many

surface heights which consist of titanium oxide or a titanium alloy oxide in part at least, A detailed pillar which stands close together on an narrow height which a large number which a layer which bristles with a surface detailed pillar which consists of titanium oxide or a titanium alloy oxide in part at least is exposed, or consist of titanium oxide or a titanium alloy oxide on a thin film followed, and this height is exposed, and For example, this height, For example, the carbon dope of this detailed pillar and this narrow height is carried out, and it is characterized by being the multifunctional material (2nd multifunctional material) which comes to give mirror surface finish by polish to a surface layer further.

[Effect of the Invention]

[0014]

Since the multifunctional material which has the 1st mirror plane of this invention is excellent in endurance (high hardness, scratch-proof nature, abrasion resistance, chemical resistance, heat resistance) and functions as a visible light response type photocatalyst, It not only can use it as a visible light response type photocatalyst, but it can use for various technical fields for which hard chromium plating was used conventionally intentionally. The potential of a substrate is reduced and the application to the product aiming at prevention of pitting, general corrosion, stress corrosion cracking, etc., etc. can be expected. If it is used as a radiation response type catalyst which answers radiation, such as not only ultraviolet rays but a gamma ray, as compared with other membrane formation techniques, membranes can be formed easily, and endurance can also be raised. Since mirror surface finish by polish is performed to the surface layer, the reflection effect of laser etc. can be acquired. Since this multifunctional material has high heat resistance, it is suitable for especially using for the light reflector of the high intensity light which is an elevated temperature.

[0015]

Photocatalyst activity is high, the multifunctional material which has the 2nd mirror plane of this invention functions as a visible light response type photocatalyst, and also can stick also to VOC easily, and its hardness is also high, it is excellent in peeling resistance, abrasion resistance, chemical resistance, and heat resistance, and can also acquire the reflection effect of high intensity lights, such as laser, further.

[0016]

Also when the multifunctional material which has a mirror plane of this invention does not almost have corroding also when it uses in sea water and medicine with the endurance and it is used by organic disintegration all over the sea, adhesion of a marine organism is reduced. Even if the multifunctional material which furthermore has a mirror plane of this invention is used at a humid place, the antifog effect by optical hydrophilic nature is revealed, and it is effective in being hard to bloom cloudy.

[0017]

If using the 1st multifunctional material if endurance is thought as important thinks photocatalyst activity desirable height as important, it will be preferred to use the 2nd multifunctional material.

[Best Mode of Carrying Out the Invention]

[0018]

Hereafter, the one best gestalt for carrying out this invention is explained.

[0019]

Although the multifunctional material which has the 1st mirror plane of this invention can manufacture the surface of the base in which a surface layer consists of titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide at least by, for example, heat-treating hydrocarbon at an elevated temperature using the burning flame of the gas used as the main ingredients, This base in which a surface layer consists of titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide at least, Even if the whole base comprises any of titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide they are, it comprises the surface part formative layer and heartwood, and those construction material may differ. They may be the end product shape (plate-like and the shape of a solid) expected endurance, such as high hardness, scratch-proof nature, abrasion resistance, chemical resistance, and heat resistance, about the shape of the base, and the end product shape where the surface is wished having a visible light response type photocatalyst function.

[0020]

When the base in which a surface layer consists of titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide at least comprises the surface part formative layer and heartwood and those construction material differs, The thickness of the surface part formative layer may be the same as that of the carbon dope titanium oxide layer thickness formed, or (that is, the whole surface part formative layer turns into a carbon dope titanium oxide layer) may be thick (that is, a part of thickness direction of the surface part formative layer serves as a carbon dope titanium oxide layer, and a part remains as it is). If the construction material of the heartwood burns, is fused or does not change in the case of the heat-treatment in the manufacturing method of the 1st invention, it will not be restricted in particular. For example, iron, an iron alloy, a nonferrous alloy, ceramics, other pottery, high-temperature-heat-resistance glass, etc. can be used as heartwood. As a base which comprises such a filmy surface layer and heartwood, For example, the thing which formed the coat which consists of titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide on the surface of heartwood by methods, such as sputtering, vacuum evaporation, and thermal spraying, Or what gave commercial titanium oxide sol on the surface of heartwood by spray coating, spin coating, or dipping, and formed the coat can be mentioned.

[0021]

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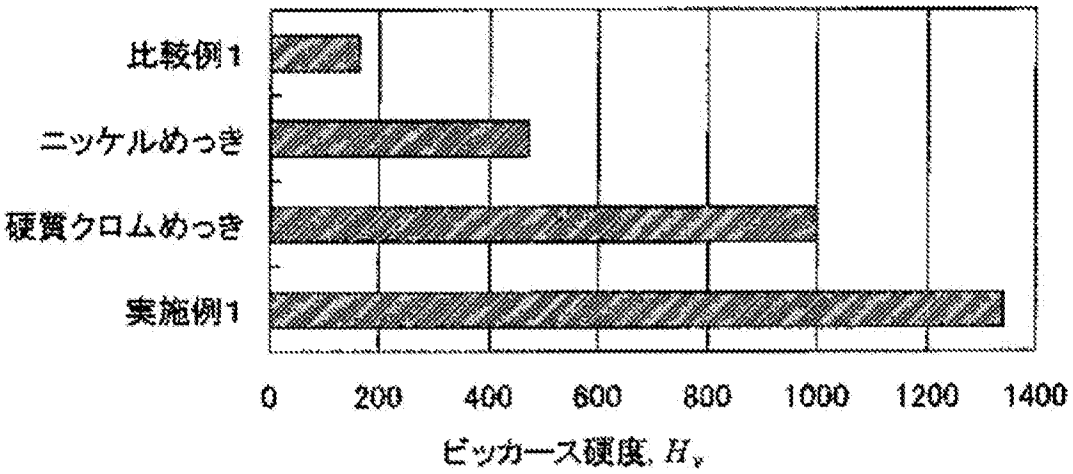
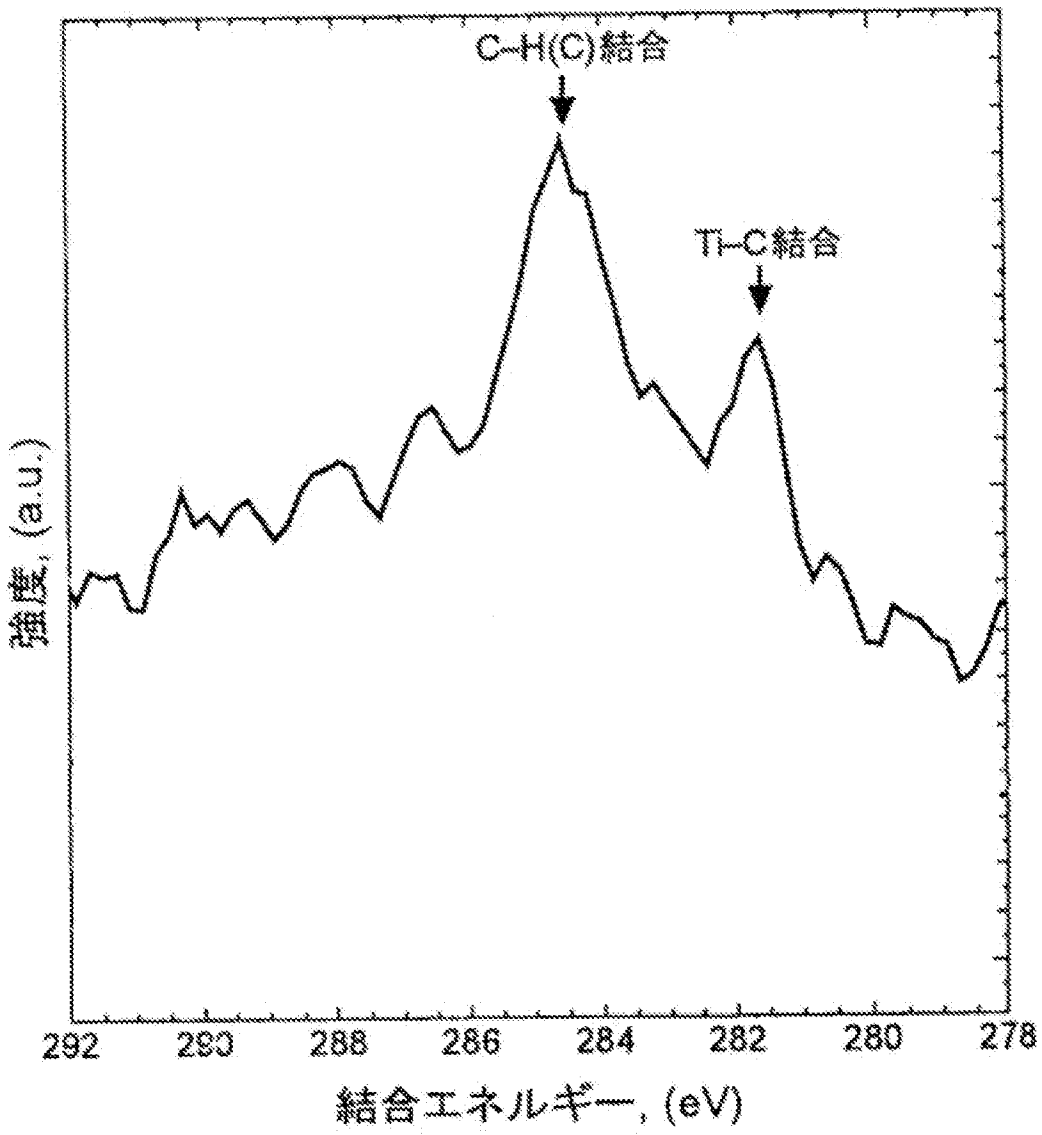
DRAWINGS

[Drawing 1]



[Drawing 2]



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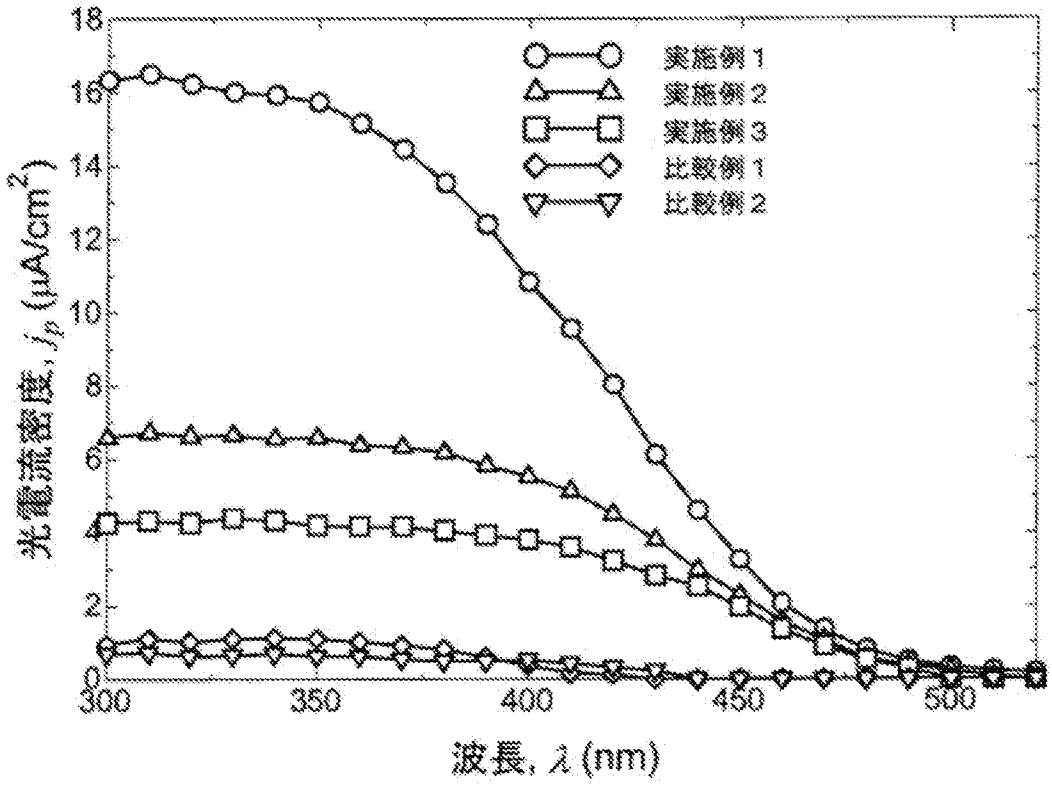

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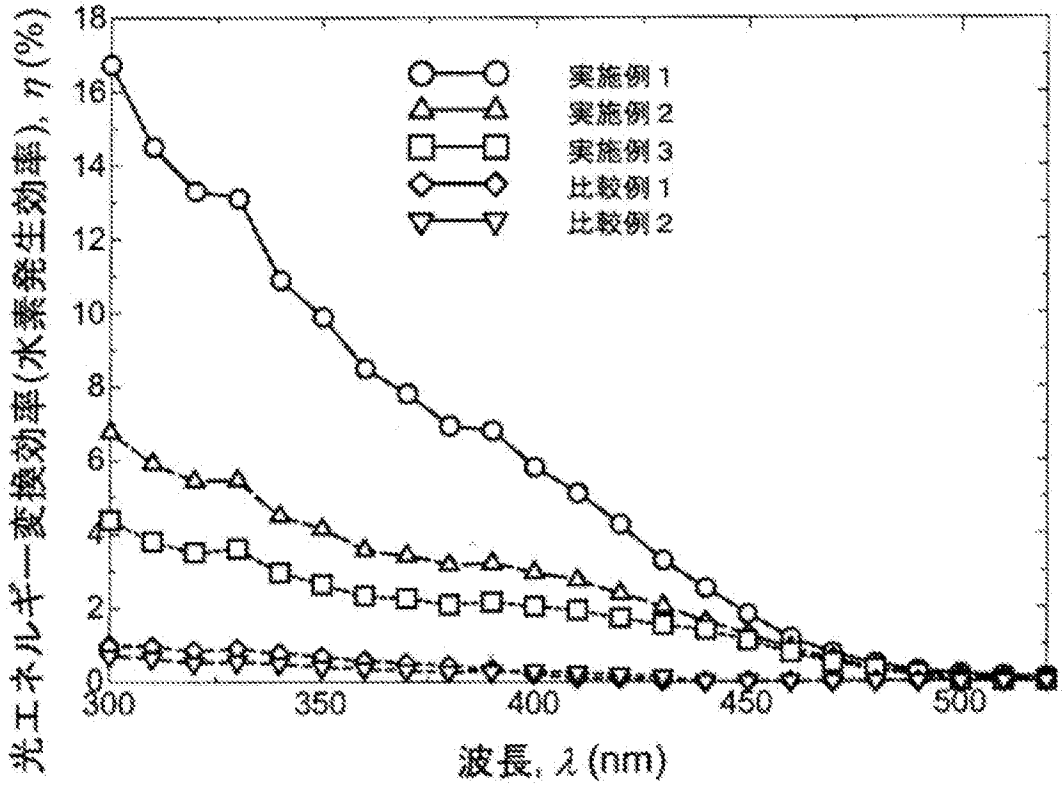

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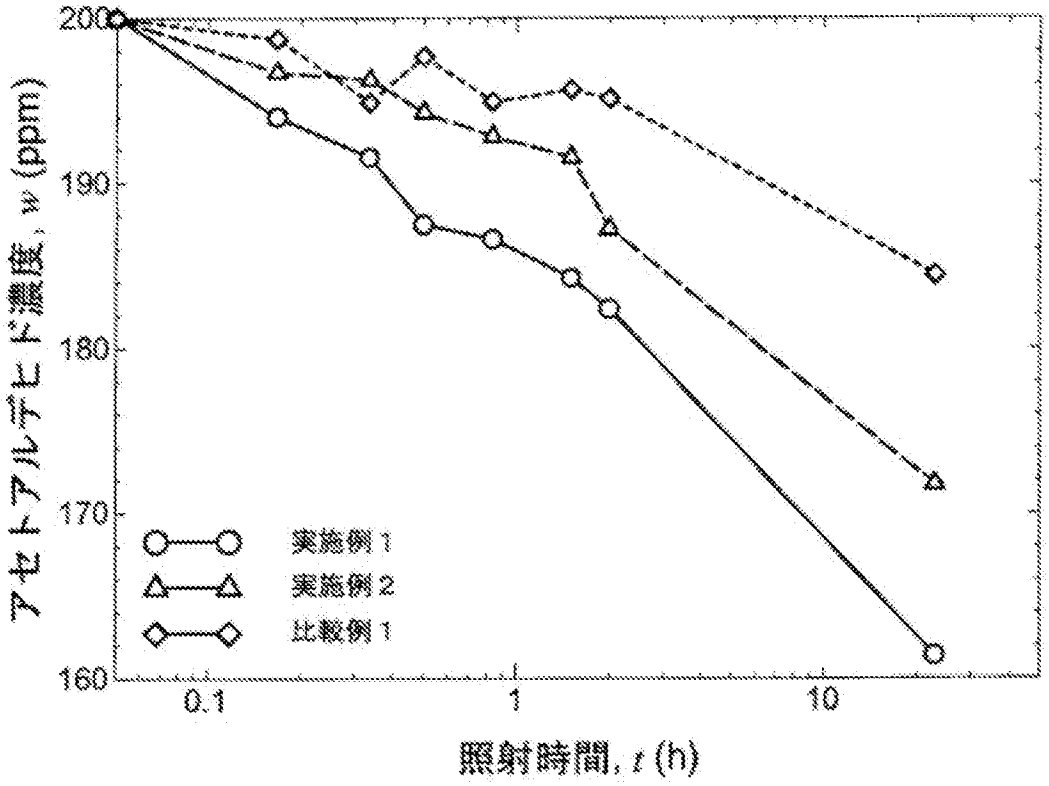
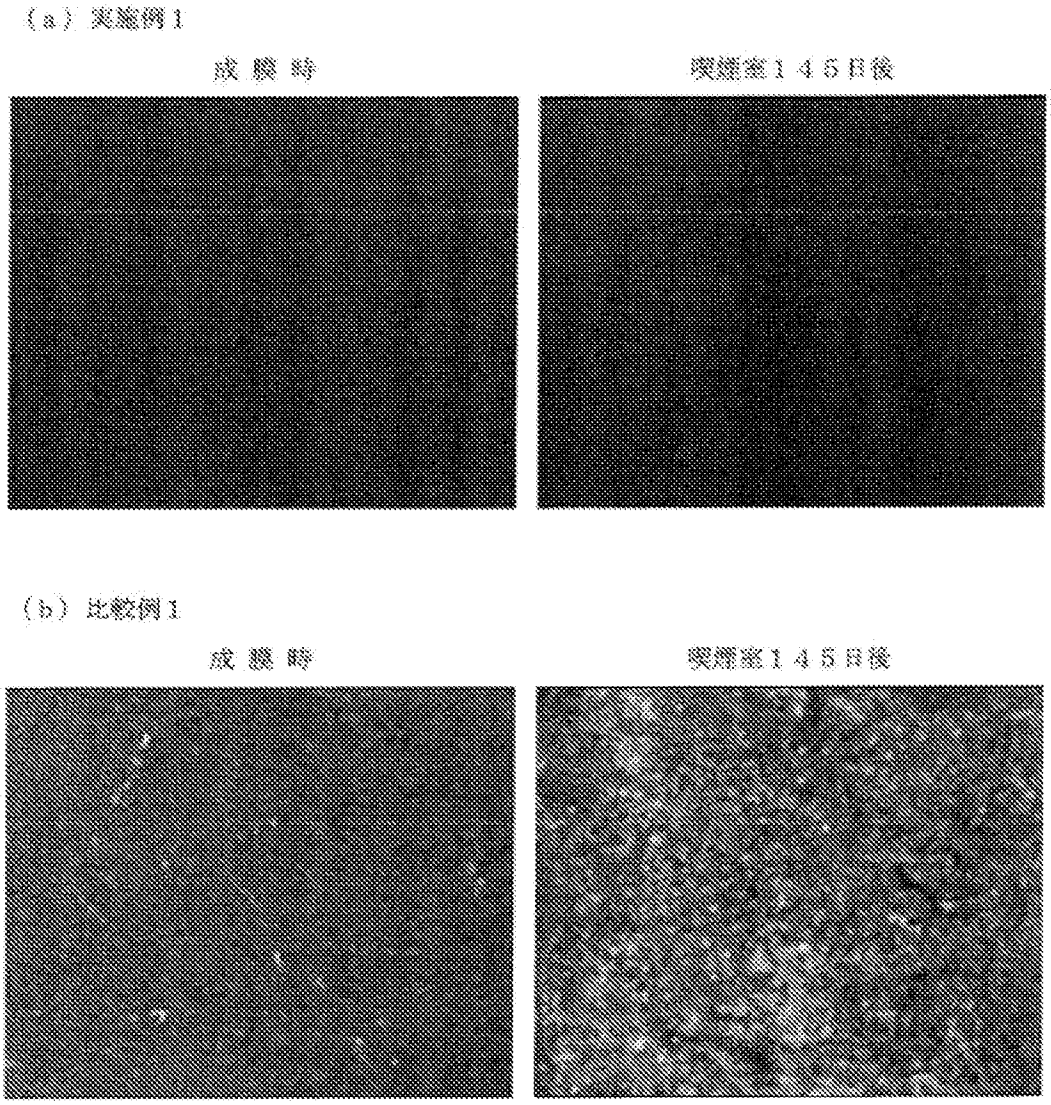

200
190
180
170
160
0.1
1
10
アセトアルデヒド濃度, w (ppm)
照射時間, t (h)
実施例1
実施例2
比較例1

[Drawing 6]



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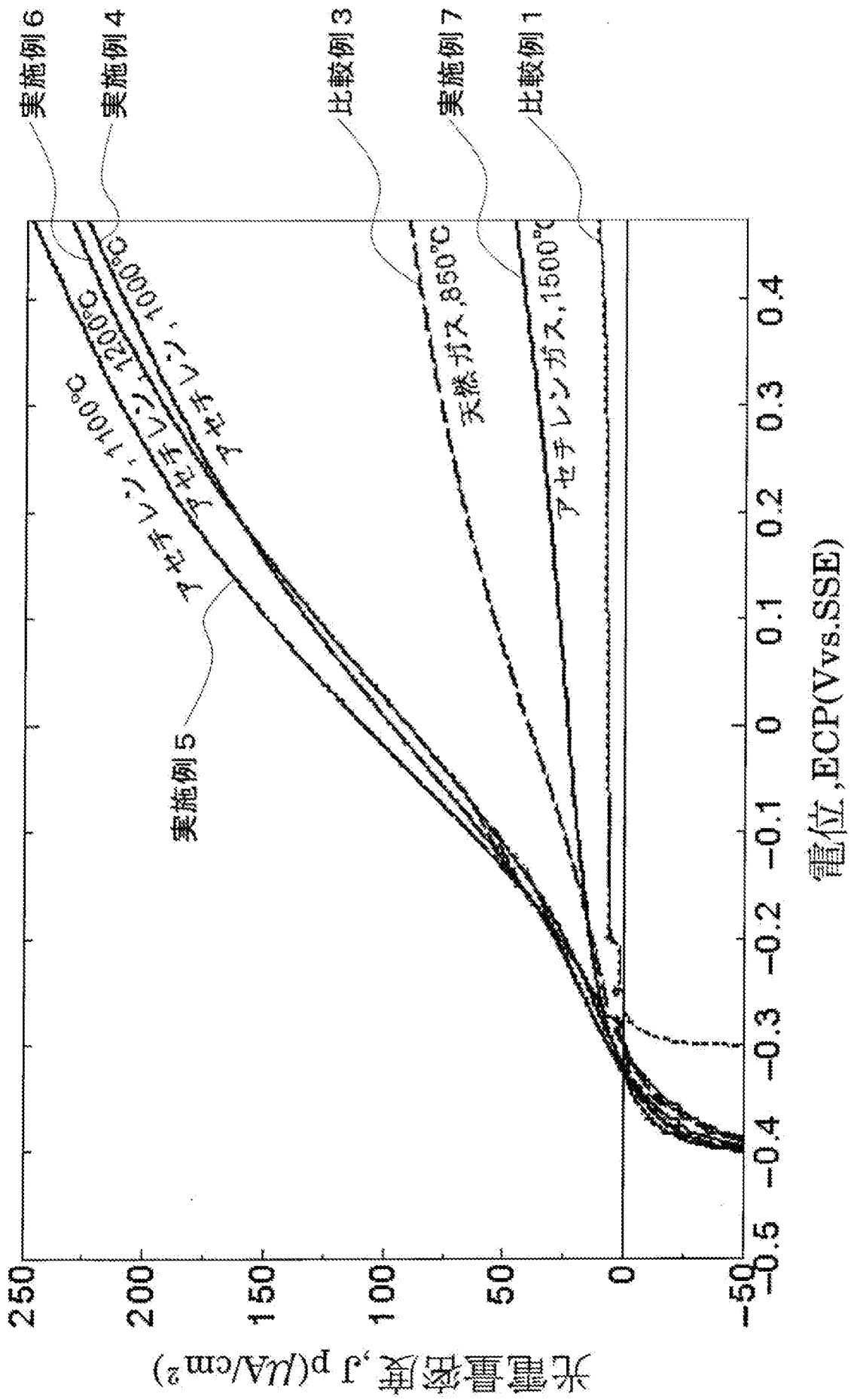
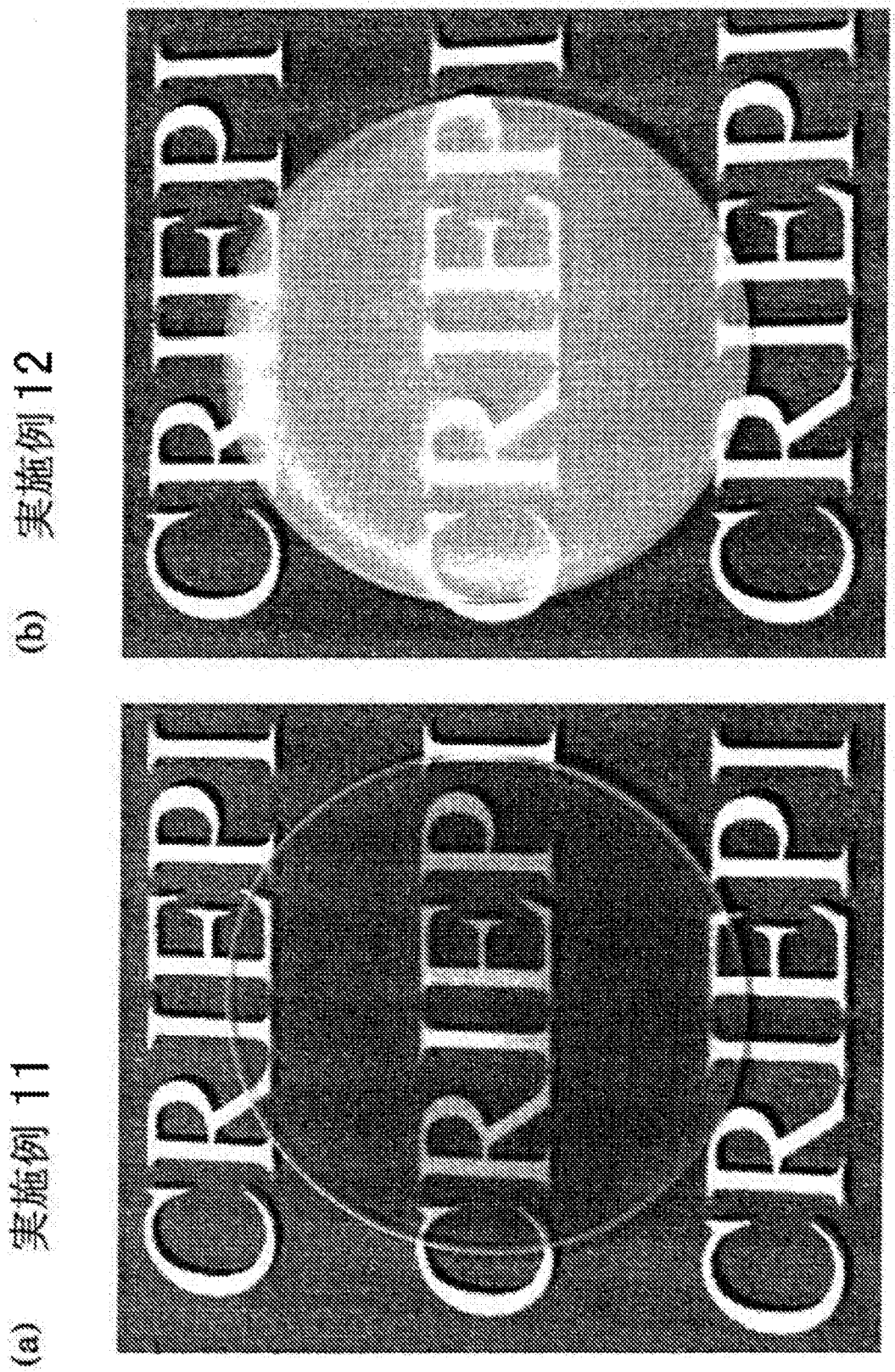

実施例6
実施例4
比較例3
実施例7
比較例1
実施例5
アセチレンガス,1500°C
天然ガス,850°C
アセチレン,1200°C
アセチレン,1000°C
アセチレン,1100°C
光電量密度,J p(μA/cm²)
250
200
150
100
50
0
−50
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
電位,ECP(Vvs.SSE)

[Drawing 8]



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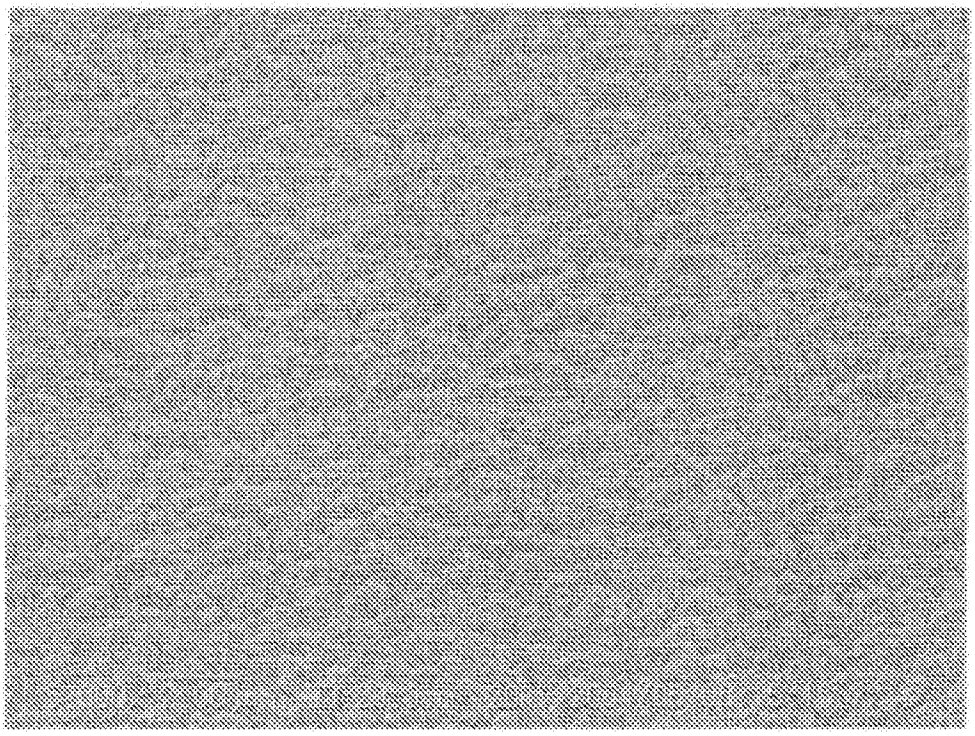

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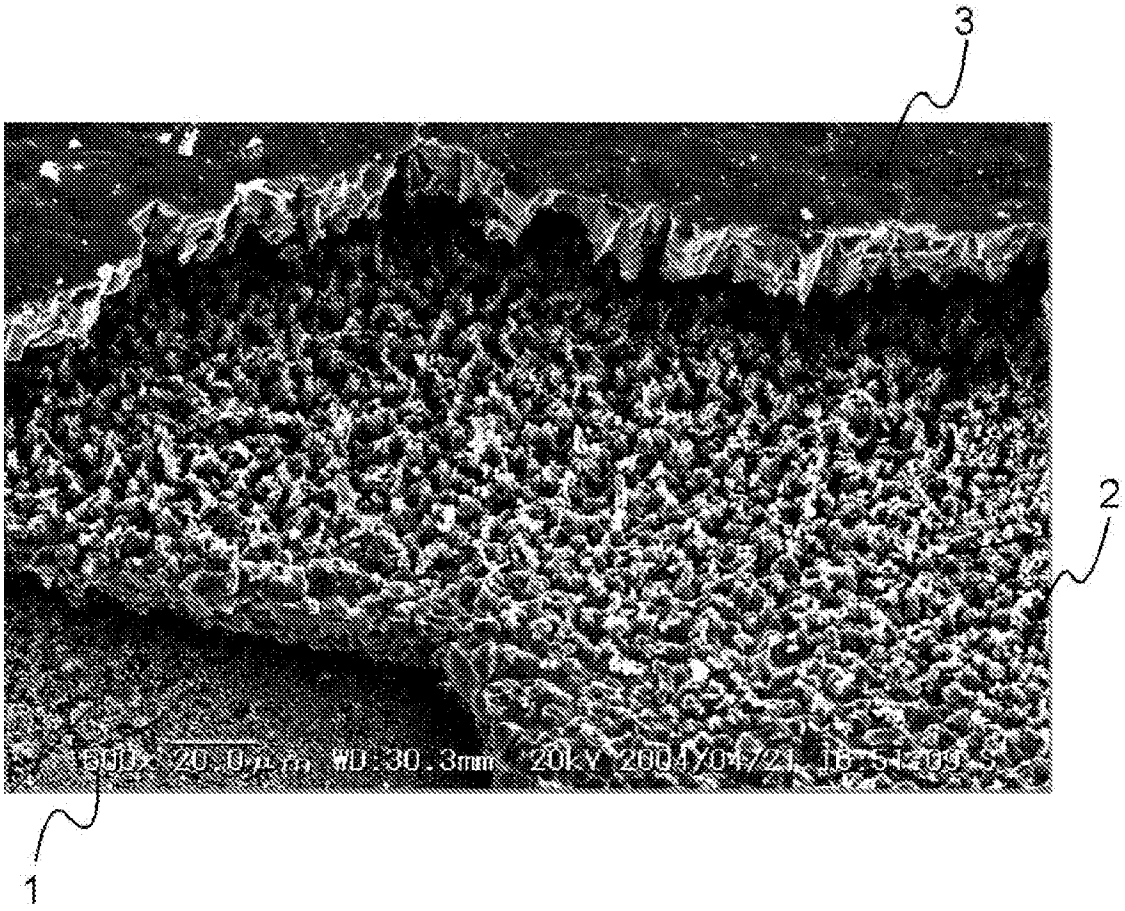

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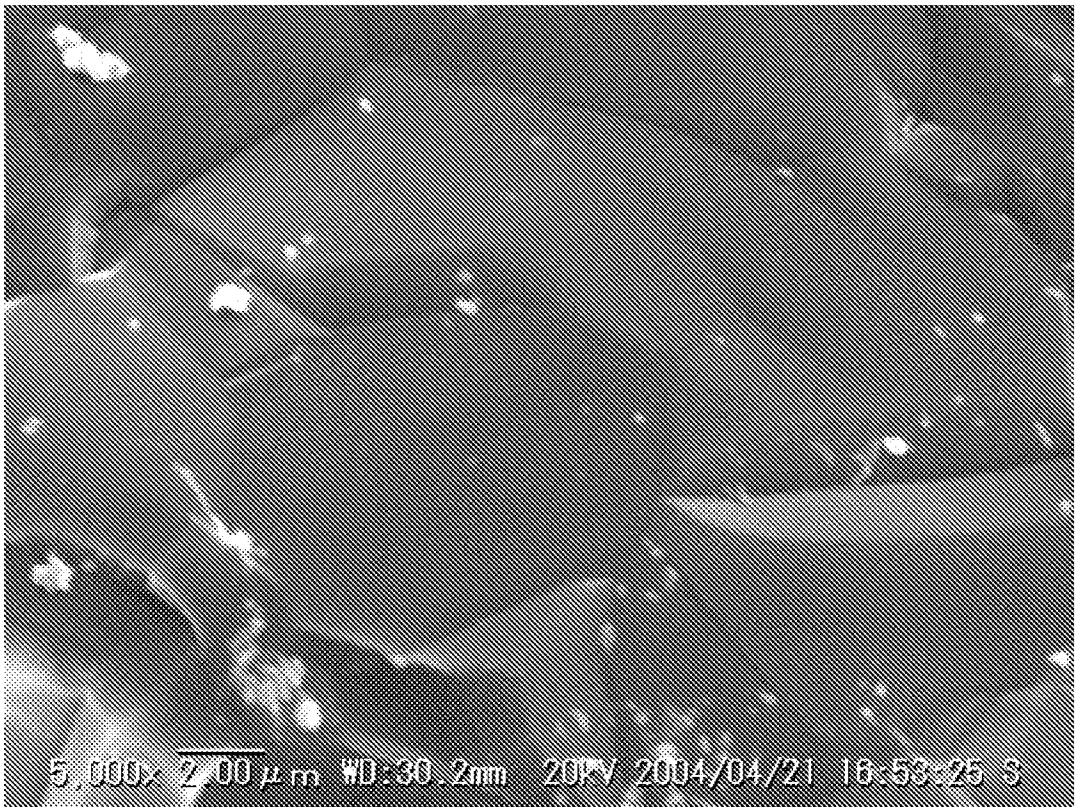
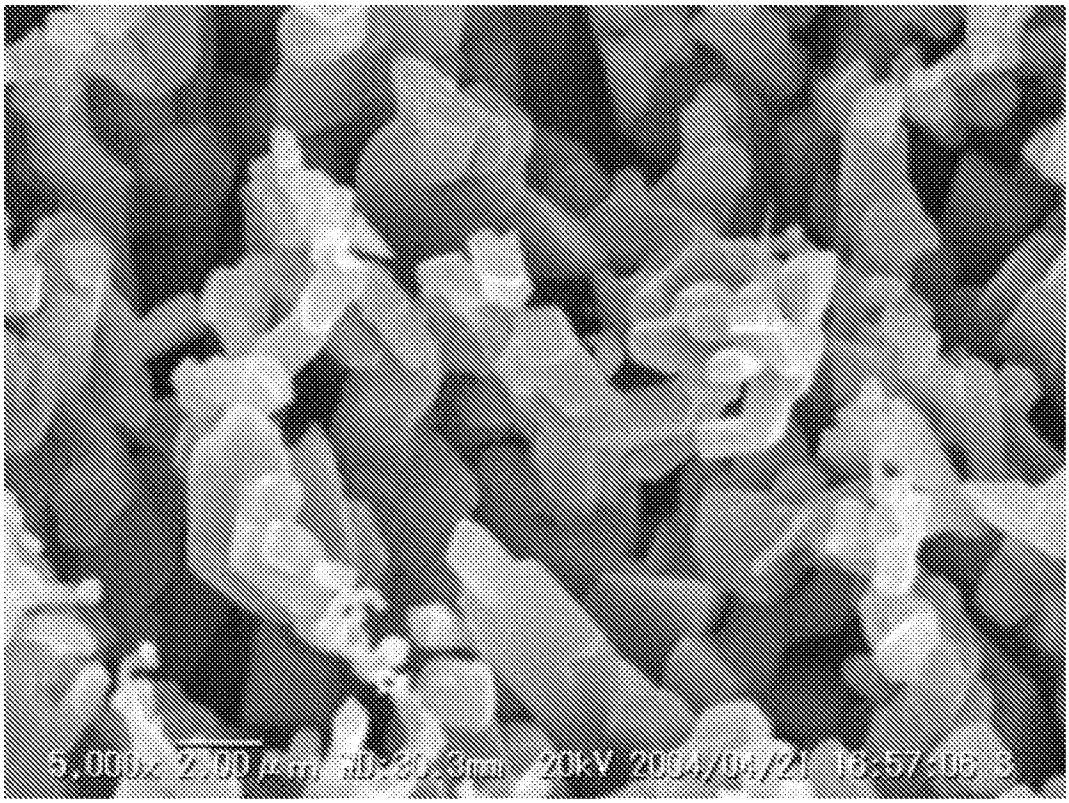


[Drawing 12]

[Drawing 13]



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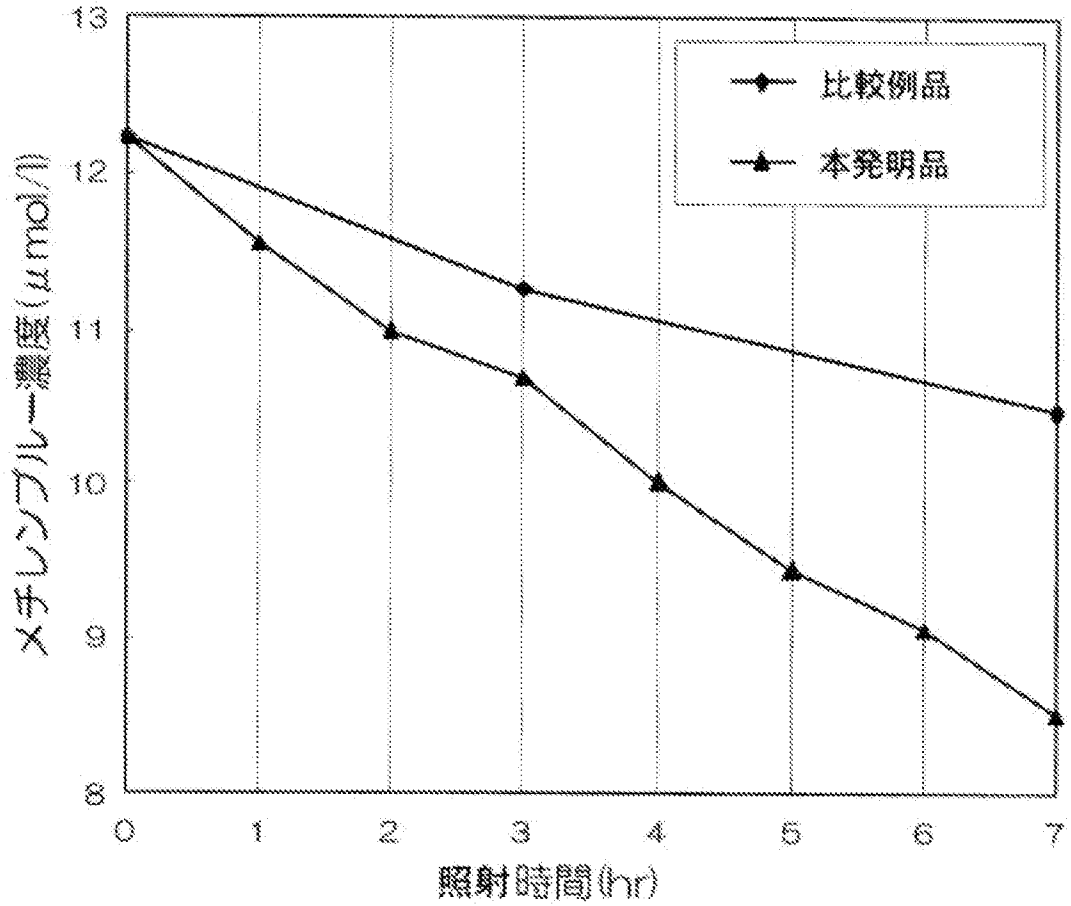

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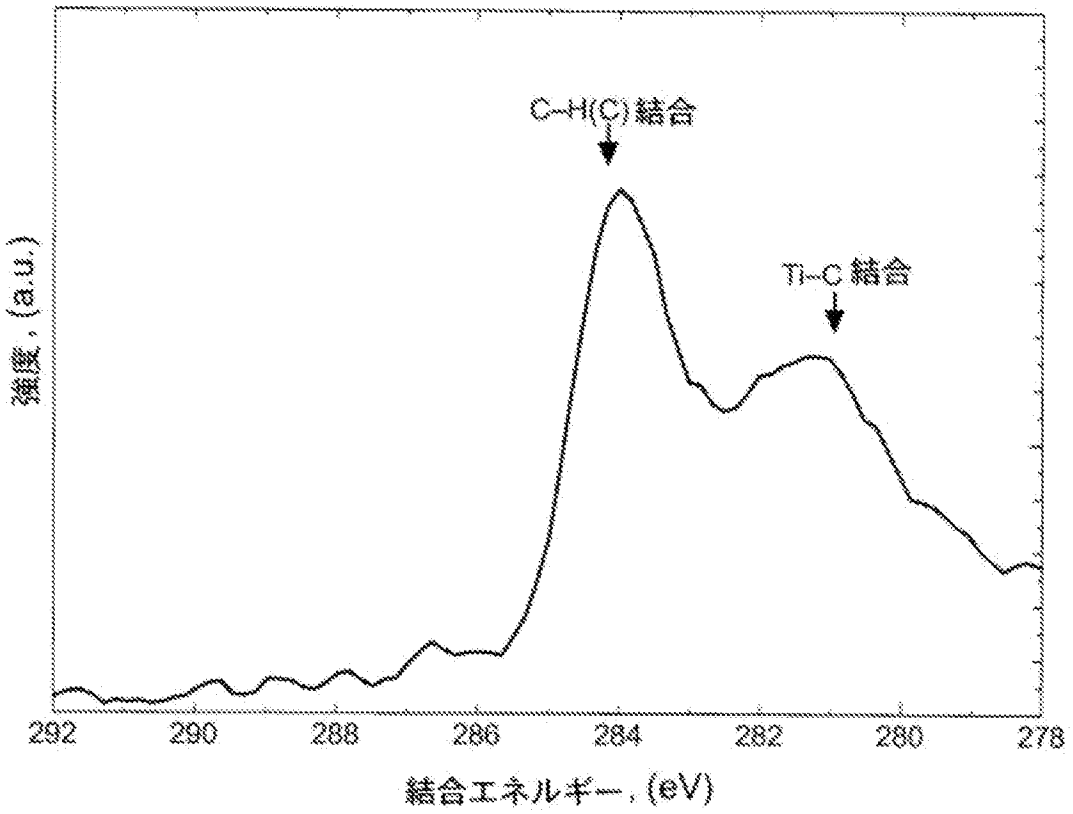
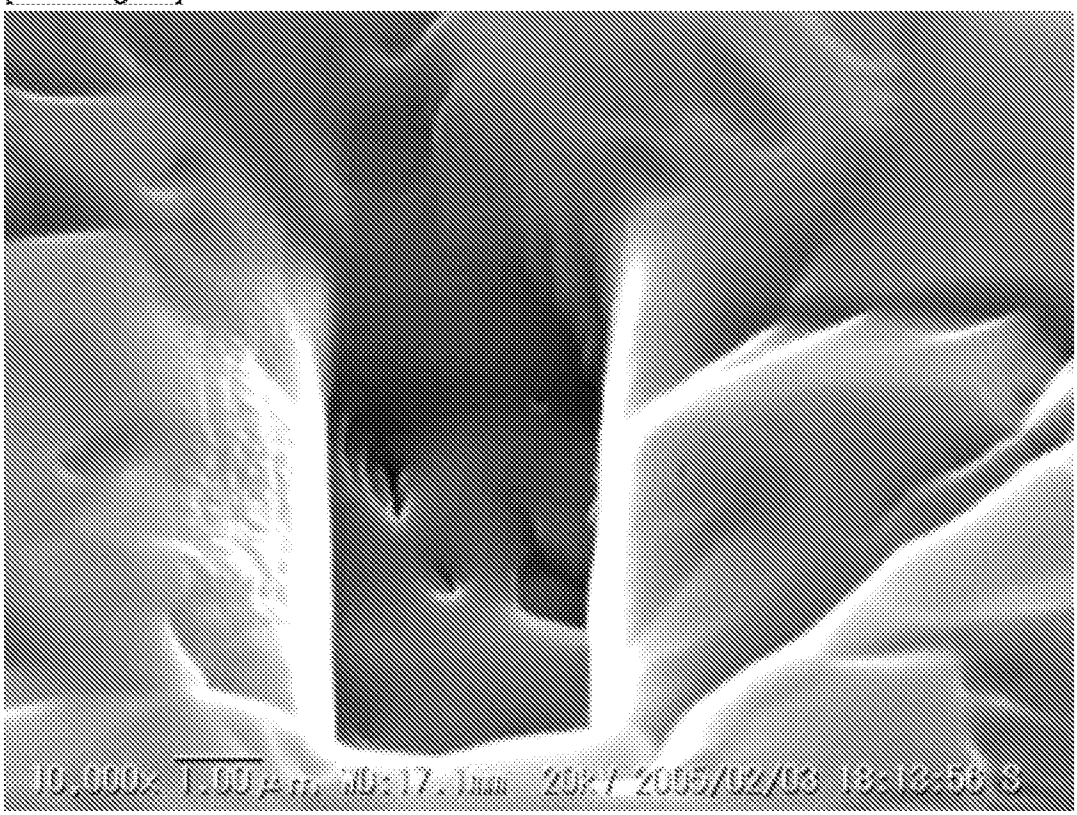
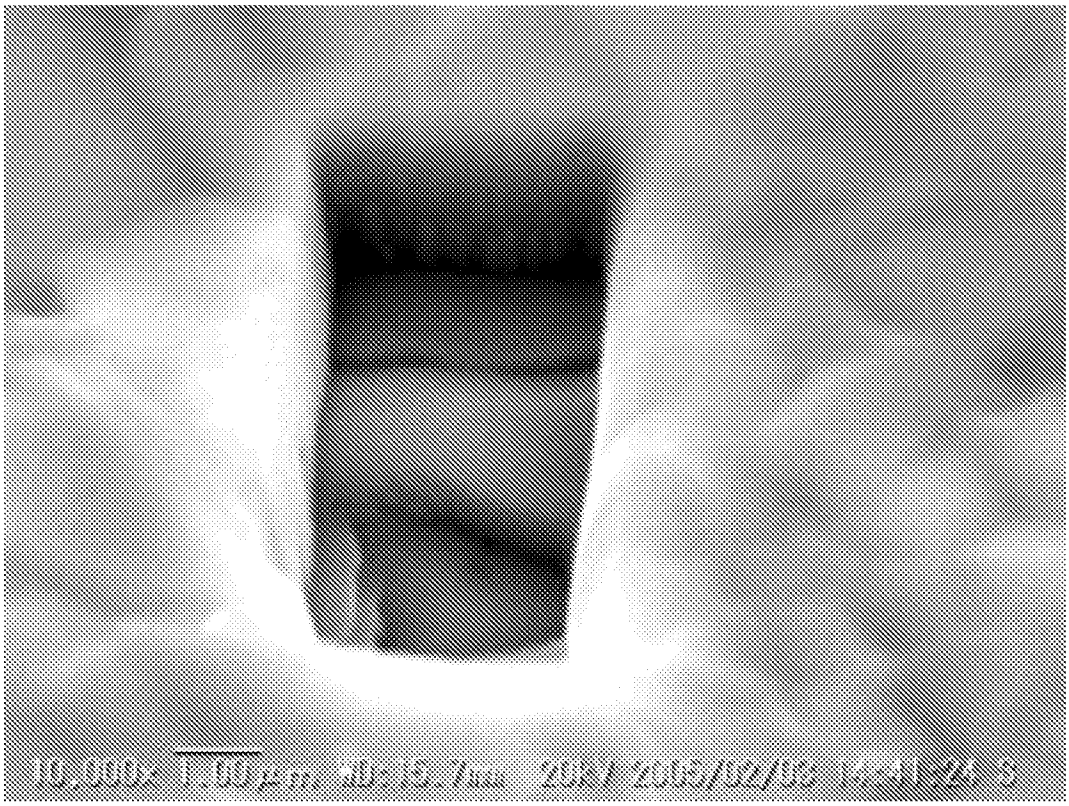


[Drawing 16]



[Drawing 17]



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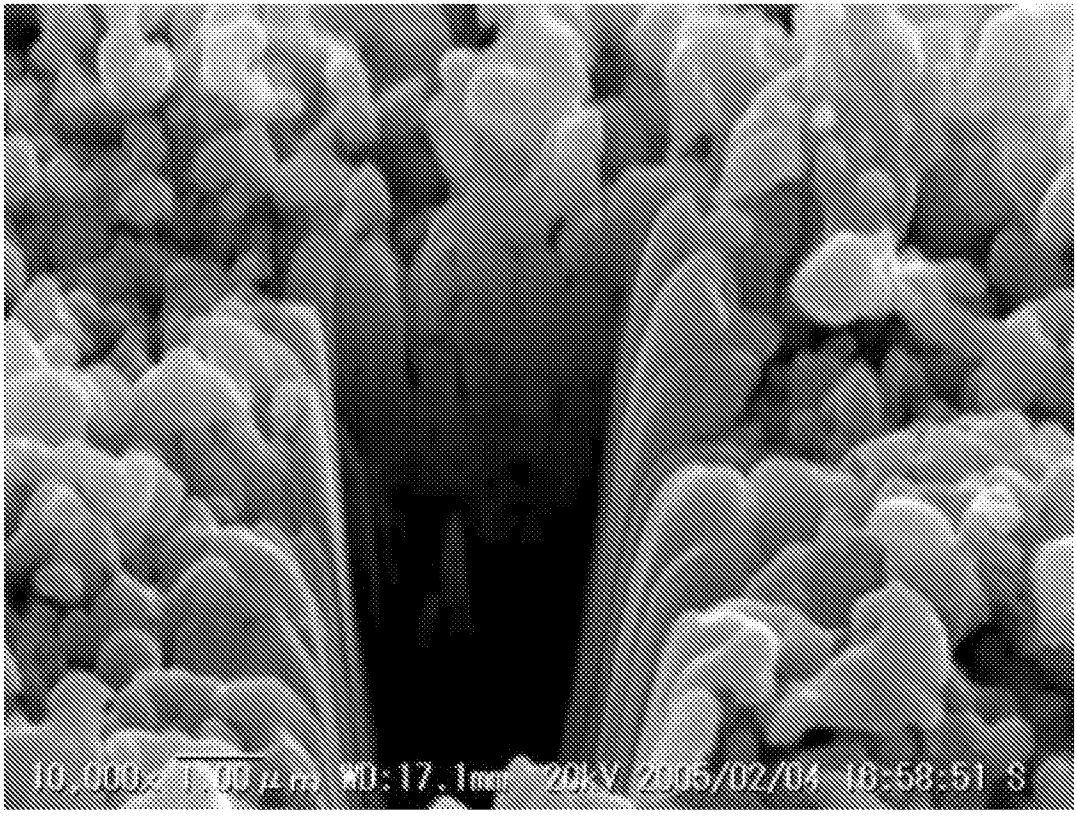

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